# A FUSED CLUSTER OF CONIFORM CONODONT ELEMENTS FROM THE LATE ORDOVICIAN OF WASHINGTON LAND, WESTERN NORTH GREENLAND

*by* R. J. ALDRIDGE

ABSTRACT. A fused conodont cluster, comprising six distacodontiform elements and one oistodontiform element, from upper Ordovician limestones of the Aleqatsiaq Fjord Formation of Washington Land, north Greenland, is described. A notable microstructural feature of all the elements is the presence of oblique striations along the anterior margins of the lateral faces. The distacodontiform elements are similar to elements included in *Acodus*? *mutatus* (Branson and Mehl) and *Dapsilodus obliquicostatus* (Branson and Mehl), but the apparatus structure appears to be different and the cluster is assigned to *Besselodus arcticus* gen. et sp. nov.

CONODONT elements are normally found as isolated, discrete specimens, and until the mid 1960s conodont taxonomy and nomenclature were almost entirely based on the morphology of single elements. A multielement concept of conodont species was first proposed over a hundred years ago, by Hinde (1879), and the discovery of 'natural assemblages' of conodonts on shale bedding surfaces by Schmidt (1934) and Scott (1934) provided direct evidence that each animal possessed a skeletal apparatus consisting of different element types. Subsequently, several hundred similar associations, each representing the skeletal remains of an individual animal, have been found, mostly in Carboniferous shales (e.g. Scott 1942; DuBois 1943; Rhodes 1952). Descriptions of many of these naturally occurring apparatuses have yet to be published. Additional evidence of apparatus structures is provided by fused conodont clusters recovered from acid-insoluble residues (e.g. Rexroad and Nicoll 1964; Austin and Rhodes 1969; Pollock 1969; Ramovs 1977, 1978), most of which represent complete or partial apparatuses.

Once the multielement structure of conodont apparatuses was appreciated it was only a matter of time before workers began to reconstruct apparatuses from collections of isolated specimens. Walliser (1964), for example, suggested reconstructions of nine Silurian conodont apparatuses (informally named 'Conodonten-Apparat' A–J), although no naturally occurring apparatuses or clusters were at that time known from the Silurian. A transition of emphasis in conodont taxonomy from a single element to a multielement basis has followed as more and more reconstructions, based on statistical, distributional, and morphological evidence, have been published. Huddle (1972) has documented the development of the early phases of this transition. Of importance in this taxonomic revolution was the realization that apparatuses conform to a limited number of basic plans (Klapper and Philip 1971; Barnes, Kennedy, McCracken, Nowlan, and Tarrant 1979). Hence, the structures exhibited by naturally occurring apparatuses and clusters, together with those of well-established reconstructions, can serve as models in the analysis of new collections.

Naturally occurring apparatuses and clusters are rare, and it is probable that the apparatuses of most species will be recognized entirely from collections of isolated elements. However, the direct evidence furnished by natural associations is of paramount importance to multielement taxonomy; not only do they provide templates for reconstructions, but new finds allow testing and evaluation of current hypotheses. Additionally, it is only from these associations that we can confidently assess the relative numbers and dispositions of the component elements.

The only natural associations of late Ordovician conodonts recorded to date are three clusters

**[Palaeontology, Vol. 25, Part 2, 1982, pp. 425–430, pl. 44.]**

of *Belodina compressa* (Branson and Mehl) from Canada (Barnes 1967; Nowlan 1979). Another cluster, also of coniform elements, has recently been isolated from late Ordovician limestones of northern Greenland. Although the material is limited, the apparatus differs in structure from those reconstructed for similar Ordovician and Silurian elements, and the cluster is assigned to a new taxon, *Besselodus arcticus*.

## SAMPLE LOCALITY AND HORIZON

The cluster was recovered from Geological Survey of Greenland sample no. GGU 242821, collected by Dr. J. M. Hurst from the Aleqatsiaq Fjord Formation of Aleqatsiaq Fjord, Washington Land, western North Greenland (see Peel and Hurst 1980; Hurst 1980). The sample of fissile, argillaceous calcilutite is from 132 m above the base of the formation and approximately 140 m below the top. The conodont fauna includes *Amorphognathus* aff. *ordovicicus* Branson and Mehl, which is also present in samples GGU 242820 and GGU 242822, from 20 m below and above the horizon. A late Ordovician, Ashgill, age is indicated.

## THE CONODONT FAUNA

The 730 gm sample available for processing yielded only a small number of conodont specimens. Some of these are fragmentary, but the following are identifiable:

| | | |
|---|---|---|
| *Amorphognathus* aff. *ordovicicus* (Branson and Mehl) | | |
| | Pa element | 1 |
| | Sa element | 2 |
| *Belodina compressa* (Branson and Mehl) | | |
| | compressed rastrate element | 1 |
| | eobelodiniform element | 1? |
| *Besselodus arcticus* gen. et sp. nov. | | |
| in cluster: | distacodontiform element | 6 |
| | oistodontiform element | 1 |
| isolated: | distacodontiform elements | 8? |
| | oistodontiform elements | 5? |
| *Coelocerodontus trigonius* Ethington | | 1 |
| *Ouludus*? sp. | Sc element | 4 |
| *Panderodus* sp. | | 2 |
| *Pseudobelodina*? sp. | rastrate element | 1 |
| *Pseudooneotodus* sp. | | 1 |

Isolated specimens similar to those of *Besselodus arcticus* occur sporadically and in small numbers throughout the lower and middle Aleqatsiaq Fjord Formation. Small acodontiform elements are occasionally found in the same samples, but it is not at present possible to ascertain whether these specimens belong in *Besselodus* or represent another apparatus.

## SYSTEMATIC DESCRIPTION

### Genus BESSELODUS gen. nov.

*Type species. Besselodus arcticus* sp. nov.; from the Aleqatsiaq Fjord Formation of Washington Land.

*Diagnosis.* The apparatus contains at least two members, distacodontiform and oistodontiform. All known elements are laterally compressed with sharp anterior and posterior edges.

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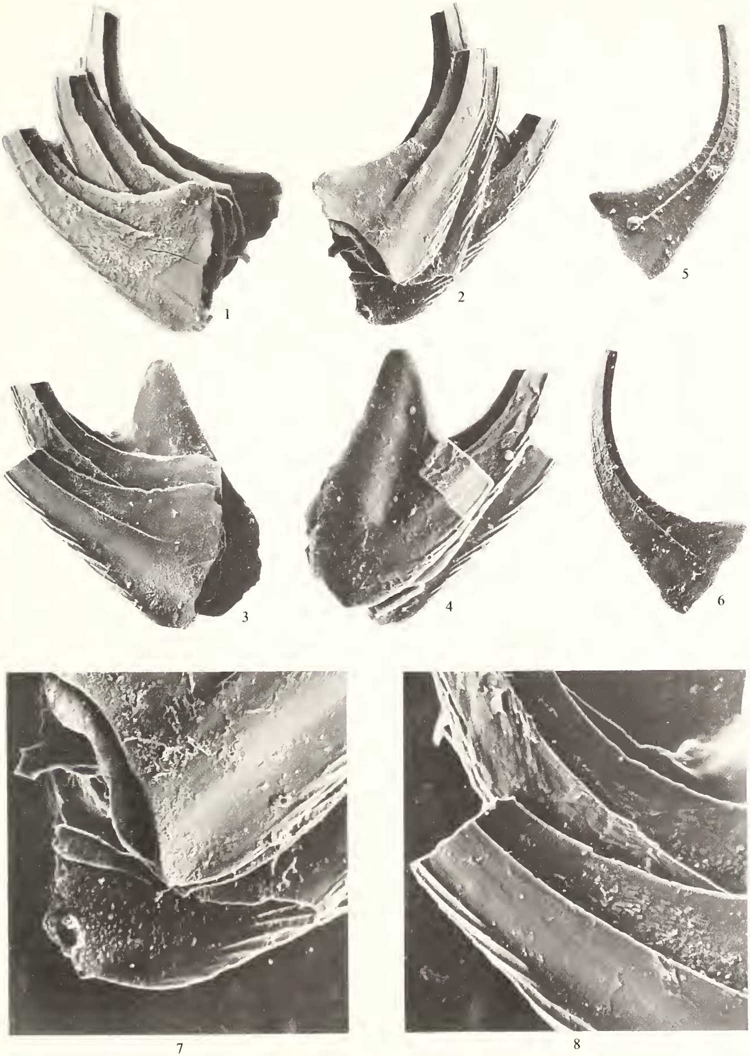
EXPLANATION OF PLATE 44

Figs. 1–8. *Besselodus arcticus* gen. et sp. nov. 1–2, lateral views of sub-cluster 'a', partial holotype, MGUH 15071, ×250. 3–4, lateral views of sub-cluster 'b', partial holotype, MGUH 15072, ×250. 5–6, lateral views of isolated specimen, MGUH 15073, ×250. 7, detail of partial holotype MGUH 15071, ×660. 8, detail of partial holotype MGUH 15072, ×660.




ALDRIDGE, fused conodont cluster

*Discussion.* Distacodontiform (=acontiodontiform) elements similar to those of *Besselodus* are included in the reconstructions of the Silurian genus *Dapsilodus* (Cooper 1976, p. 211) and of the Ordovician species *Acodus*? *mutatus* (Branson and Mehl). The generic assignment of *A*.? *mutatus* was discussed fully by Löfgren (1978, pp. 43–45), who pointed out that the apparatuses of the type species of *Acodus*, *Distacodus*, and *Acontiodus* are all unknown.

*Dapsilodus* has an apparatus of distacodontiform, modified distacodontiform and acodontiform elements (Barrick 1977, p. 50); no oistodontiform element is included, nor are there any oistodontiform or modified oistodontiform elements known from the Silurian that might be considered as homologous to the oistodontiform of *Besselodus*. *A*.? *mutatus* also has an apparatus that includes distacodontiform and acodontiform elements (Bergström and Sweet 1966, pp. 303–305), although there have been suggestions that an oistodontiform element should also be included here (Barnes and Poplawski 1973, p. 779; Sweet, in Cooper 1976, p. 211). This has been contested by Löfgren (1978, pp. 45, 57), who found no distributional relationship between oistodontiforms and elements of *A*.? *mutatus* in her early Ordovician samples from northern Sweden. The oistodontiform included by Barnes and Poplawski (1973) is *Oistodus venustus* Stauffer, which is not closely similar to the element in the cluster of *Besselodus*.

There is currently little evidence for the inclusion of an acodontiform element in *Besselodus*. None occurs in the cluster, nor are there any isolated specimens in the remainder of the, admittedly small, sample from the same horizon.

### *Besselodus arcticus* sp. nov.

Plate 44, figs. 1–8

*Diagnosis.* The apparatus contains at least two members, distacodontiform and oistodontiform. All known elements are laterally compressed with sharp anterior and posterior edges; at the anterior margins, the lateral faces of all elements display prominent oblique striations.

*Description.* The material to hand comprises a cluster and a few isolated specimens, all from the same sample. The cluster consists of very small, delicate coniform elements, all of which are broken at the tips. The elements are all very thin and translucent and white matter cannot be distinguished. Unfortunately, the cluster fell apart into two sub-clusters on initial picking, and subsequent handling has been kept to a minimum.

Sub-cluster 'a' (Pl. 44, figs. 1, 2, 7) is 0·25 mm in maximum dimension and consists of four distacodontiform elements in subparallel orientation. Each component measures about 0·2 mm from base to broken tip and is laterally compressed with sharp anterior and posterior edges. The basal outline is a highly compressed ellipse. Each lateral face bears a longitudinal costa, slightly to the posterior of the mid-line; on those specimens where the basal portion is visible, the costae terminate sharply a short distance from the basal margin. The posterior edge of each element is gently curved; the anterior edge is more sharply curved near the basal margin, producing a slight geniculation. As far as can be ascertained all the elements are bilaterally symmetrical, or very nearly so, and there is no apparent gradation in size or curvature. Each element displays well-developed fine, parallel striae on the lateral faces at the anterior margin; at the broken tips these striae are at an angle of less than 10° to the anterior edge, towards the base this angle steadily increases to greater than 20°. The striae fade towards the base and terminate at the point of geniculation (Pl. 44, fig. 7).

Eight isolated distacodontiform specimens from the same sample show similar features, with some variation in curvature apparent. Preservation is variable; the best-preserved is illustrated in Pl. 44, figs. 5, 6. This specimen differs from those in the cluster in lacking the geniculation of the anterior edge, producing a more triangular outline for the basal portion of the unit.

Sub-cluster 'b' (Pl. 44, figs. 3, 4, 8) is 0·24 mm in maximum dimension. Two distacodontiform elements comparable with those in sub-cluster 'a' are fused in subparallel orientation; a third, broken and cracked, oistodontiform element is orientated so that its cusp is parallel to those of the distacodontiform elements. The strong geniculation of the oistodontiform results in the basal margin of the unit lying at an angle of 30° to the basal margins of the distacodontiforms. The visible lateral face of the oistodontiform shows a longitudinal costa on the posterior portion of the cusp; oblique striae at the anterior margin of the cusp are also apparent, ranging in angle from 12° at the broken tip to 20° near the geniculation, where they terminate. These striae compare closely with those displayed by the distacodontiform elements.

There are five small, isolated oistodontiform specimens in the sample, but those examined under the scanning electron microscope do not exhibit clear oblique marginal striations; they may or may not be referable to the same species as the cluster.

*Holotype*. MGUH 15071 and MGUH 15072, separated portions of a single cluster from sample GGU 242821; deposited in the type collection of the Geologisk Museum, Copenhagen.

*Discussion*. The cluster probably represents a partial, rather than a complete, apparatus. The presence of a single oistodontiform may indicate that it is a partial or complete half-apparatus. In addition to the general similarity of the morphology of the distacodontiform elements, the oblique striae on the anterior margins of the elements may indicate a relationship to *Dapsilodus*. Similar striae are apparent on specimens of *D. obliquicostatus* figured by Serpagli (1970, pl. 23, figs. 1–10, pl. 24, figs. 1–6), Cooper (1976, pl. 2, figs. 11–12, 18–20), and Barrick (1977, pl. 2, figs. 6, 10). Serpagli (1970) noted the absence of similar striations on specimens referred to the older, possibly ancestral, species *Acodus*? *mutatus*. In the material referred to that species by Löfgren (1978, p. 44, pl. 2, figs. 9–21) longitudinal striations are developed and a single specimen (pl. 2, fig. 11A, B) also possesses anterior striae at an angle of 5–10° to the anterior margin. The presence of anterior striae may not be an important character in determining relationships, as they are displayed by other specimens, and are apparent in the clusters of *Belodina compressa* figured by Nowlan (1979, especially fig. 35.2).

*Acknowledgements*. This contribution arises from a major co-operative project with the Geological Survey of Greenland; I am grateful to them for providing the sample, especially to Drs. J. M. Hurst and J. S. Peel for collecting the material and arranging the loan. Mr. A. Swift processed the sample in the laboratory and first recognized the cluster. I also thank Mr. L. Green and Mr. D. J. Jones for photographic assistance. Dr. Anita Löfgren (University of Lund) kindly read and commented on the typescript. This paper is published with the permission of the Director of the Geological Survey of Greenland.

## REFERENCES

AUSTIN, R. L. and RHODES, F. H. T. 1969. A conodont assemblage from the Carboniferous of the Avon Gorge, Bristol. *Palaeontology*, **12**, 400–405.

BARNES, C. R. 1967. A questionable natural conodont assemblage from Middle Ordovician limestone, Ottawa, Canada. *J. Paleont*. **41**, 1557–1560.

—— KENNEDY, D. J., MCCRACKEN, A. D., NOWLAN, G. S. and TARRANT, G. A. 1979. The structure and evolution of Ordovician conodont apparatuses. *Lethaia*, **12**, 125–151.

—— and POPLAWSKI, M. L. S. 1973. Lower and Middle Ordovician conodonts from the Mystic Formation, Quebec, Canada. *J. Paleont*. **47**, 760–790, pls. 1–5.

BARRICK, J. E. 1977. Multielement simple-cone conodonts from the Clarita Formation (Silurian), Arbuckle Mountains, Oklahoma. *Geol. and Palaeontol*. **11**, 47–68, pls. 1–3.

BERGSTRÖM, S. M. and SWEET, W. C. 1966. Conodonts from the Lexington Limestone (Middle Ordovician) of Kentucky and its lateral equivalents in Ohio and Indiana. *Bull. Am. Paleont*. **50**, 269–441, pls. 28–35.

COOPER, B. J. 1976. Multielement conodonts from the St. Clair Limestone (Silurian) of Southern Illinois. *J. Paleont*. **50**, 205–217, pls. 1–2.

DUBOIS, E. P. 1943. Evidence on the nature of conodonts. Ibid. **17**, 155–159, pl. 25.

HINDE, G. J. 1879. On conodonts from the Chazy and Cincinnati Group of the Cambro-Silurian, and from the Hamilton and Genesee-Shale divisions of the Devonian, in Canada and the United States. *Q. Jl geol. Soc. Lond*. **35**, 351–369, pls. 15–17.

HUDDLE, J. W. 1972. Historical introduction to the problem of conodont taxonomy. *Geol. and Palaeontol*. **SB 1**, 3–16, pl. 1.

HURST, J. M. 1980. Silurian stratigraphy and facies distribution in Washington Land and Western Hall Land, North Greenland. *Bull. Grønlands geol. Unders*. **138**, 1–95.

KLAPPER, G. and PHILIP, G. M. 1971. Devonian conodont apparatuses and their vicarious skeletal elements. *Lethaia*, **4**, 429–452.

LÖFGREN, A. 1978. Arenigian and Llanvirnian conodonts from Jämtland, northern Sweden. *Foss. and Strata*, **13**, 1–129, pls. 1–16.

NOWLAN, G. S. 1979. Fused clusters of the conodont genus *Belodina* Ethington from the Thumb Mountain

Formation (Ordovician), Ellesmere Island, District of Franklin. *Curr. Res. Part A, Geol. Surv. Can., Pap.* **79-1A,** 213-218.

PEEL, J. S. and HURST, J. M. 1980. Late Ordovician and early Silurian stratigraphy of Washington Land, western North Greenland. *Rapp. Grønlands geol. Unders.* **100,** 18-24.

POLLOCK, C. A. 1969. Fused Silurian conodont clusters from Indiana. *J. Paleont.* **43,** 929-935, pls. 110-112.

RAMOVS, A. 1977. Skelettapparat von *Pseudofurnishius murcianus* (Conodontophorida) im Mitteltrias Sloweniens (NW Jugoslawien). *Neues Jb. Geol. Paläont. Abh.* **153,** 361-399.

—— 1978. Mitteltriassische conodonten-clusters in Slowenien, NW Jugoslawien. *Paläont. Z.* **52,** 129-137.

REXROAD, C. B. and NICOLL, R. S. 1964. A Silurian conodont with tetanus? *J. Paleont.* **38,** 771-773.

RHODES, F. H. T. 1952. A classification of Pennsylvanian conodont assemblages. Ibid. **26,** 886-901, pls. 126-129.

SCHMIDT, H. 1934. Conodonten-Funde in ursprünglichen Zusammenhang. *Paläont. Z.* **16,** 76-85, pl. 6.

SCOTT, H. W. 1934. The zoological relationships of the conodonts. *J. Paleont.* **8,** 448-455, pls. 58-59.

—— 1942. Conodont assemblages from the Heath formation, Montana. Ibid. **16,** 293-300, pls. 37-40.

SERPAGLI, E. 1970. Uppermost Wenlockian-upper Ludlovian (Silurian) conodonts from Western Sardinia. *Boll. Soc. Paleontol. Ital.* **9,** 76-96, pls. 21-24.

WALLISER, O. H. 1964. Conodonten des Silurs. *Abh. hess. Landesamt Bodenforsch.* **41,** 1-106, pls. 1-32.

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Typescript received 27 November 1980

Revised typescript received 26 January 1981